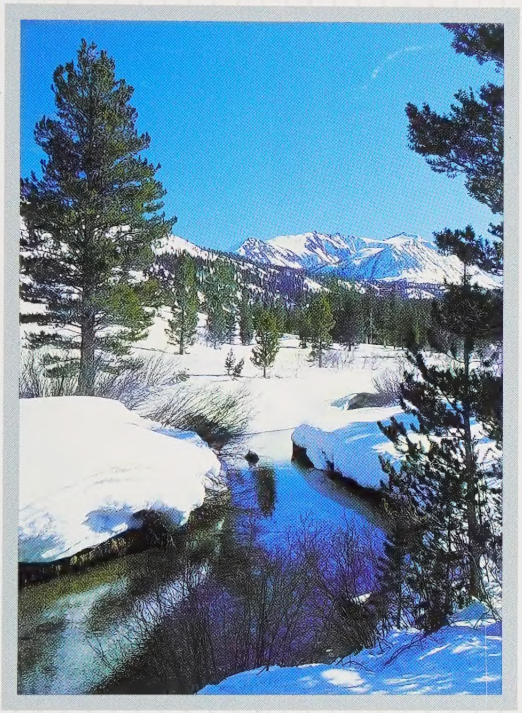
WATER



FOR LOS ANGELES

Water for Los Angeles

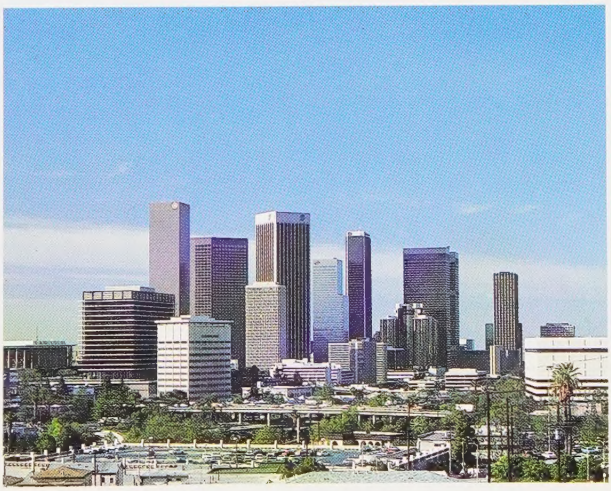
Situated in a semiarid region of little rainfall, surrounded by desert, mountains and ocean, Los Angeles has waged an unceasing struggle to provide adequate supplies of clean, wholesome water to meet its needs. By continous planning, Los Angeles has been able to provide the water needed to keep pace with growth in population, business and industry.

Of all the major cities of the world, Los Angeles has one of the most complex systems to obtain and supply water to its citizens. The water is transported over long distances and is distributed over a larger, more varying geographical area than any other major city in the United States.

Water has played a prominent role in the origin and progress of the City of Los Angeles. Development began in 1781 with the founding of the original pueblo near the Los Angles River. For many years, water was diverted from the Los Angeles River into a primitive network of "zanjas," or ditches, which served the town and carried water to irrigate crops.

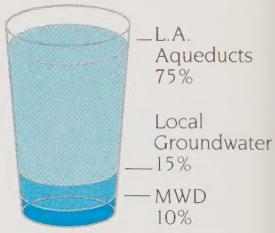
In 1868, the City contracted with a private company to provide water service for a 30-year period. In 1902 the City purchased the private water company's facilities for $2 million and established the first Board of Water Commissioners to manage the utility. The Water System has operated under municipal ownership since that date.

Water makes the difference between desert and flourishing metropolis.



Sources of Water Supply

As the City of Los Angeles grew, new sources of water were added. Today, Los Angeles has three sources to meet water requirements. Under normal conditions, wells in the San Fernando Valley and other local groundwater basins supply 15% of the water; two aqueducts from the Sierra Nevada supply 75%; and purchases from the Metropolitan Water District (MWD) furnish the balance of 10%, this supply coming from the Colorado River and the State Water Project.



The eastern Sierra Nevada is Los Angeles most important water source.

Water from the Underground

Several groundwater basins in the Los Angeles area provide the only local water source available to the City. The major portion of this supply comes from the San Fernando Valley Groundwater Basin. Groundwater accounts for 15% of the City's water supply in a normal year.

The San Fernando Valley Groundwater Basin is a natural underground reservoir that represents an important source of drinking water for approximately 500,000 people in the Los Angeles metropolitan area. It is termed an "adjudicated basin," meaning that the four cities and numerous other users that draw water from it have a legal limit to the amount of water they can withdraw. In addition to supplying the annual water needs, this groundwater basin holds large quantities of stored water which can be extracted during droughts and replenished during years of surplus water supply. Enough well capacity and stored water are available in the basin to supply about one million people for two years in a drought.

As with all groundwater basins, the one beneath the San Fernando Valley must be recharged to replenish water that is taken out. The greatest amount of recharge comes from rain water that filters down through the gravels of the San Fernando Valley to the underground basin. Spreading grounds are used to allow additional rain water from the Los Angeles River and local creeks and surplus Los Angeles Aqueduct water to percolate into the groundwater basin.

A system of wells in the San Fernando Valley is used to pump water from the underground into the distribution system. There are some 90 active production wells, 12 inches to 24

Spreading grounds help recharge the underground water basins.

in diameter, in the San Fernando Valley and in other parts of the City. Together they produce an average of 90 million gallons of water per day. Groundwater wells in the Valley average several hundred feet in depth, while those elsewhere in the City are as deep as 1,500 feet beneath the ground to tap fresh water sources.

The Los Angeles Aqueduct System

Los Angeles Owens River Aqueduct

In 1902, the newly created Water Department recognized the need to develop additional water sources to ensure the continued growth of the City. The people responded in 1905 and 1907 by voting overwhelmingly in favor of two bond issues totaling $24.5 million, which permitted construction of the Los Angeles Owens River Aqueduct.

The 233-mile aqueduct taps the snow-fed streams on the eastern slopes of the Sierra Nevada. Completed in 1913, it was widely regarded as a miracle of water engineering because of the unique feature that water flowed by gravity over its entire route from the Owens Valley to Los Angeles.

From its intake in the Owens Valley, the aqueduct passes over foothills, through mountains and across the Mojave Desert into Los Angeles. Water travels through 142 tunnels and across 9 major canyons to complete the journey.

In 1940, the aqueduct was extended 105 miles to tap the waters of the Mono Basin. An 11-mile tunnel was drilled through the Mono Craters to obtain water from four mountain streams. Dams were built at Grant Lake and Long Valley. Long Valley Dam created Crowley Lake Reservoir, the largest in the City's water system. The Mono Basin project extended the length of the Los Angeles Aqueduct system to a total of 338 miles, and brought the capacity of the system to about 300 million gallons per day.

The Los Angeles Aqueduct brings eastern Sierra water to the City.

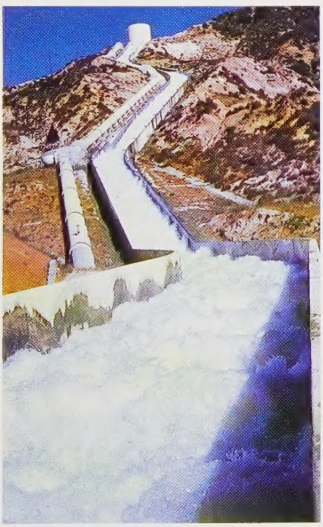
Second Los Angeles Aqueduct

DWP long recognized that the supply of water in the Owens River-Mono Basin area exceeded the delivery capacity of the original aqueduct. In the late 1950s and early 1960s, several factors entered the water supply scenario which encouraged DWP to pursue additional supplies from the eastern Sierra watershed. MWD's loss of some water rights on the Colorado River, projected costs of the energy-intensive MWD supplies, and higher water quality all played key roles in forming the decision to bring more eastern Sierra water to the southland.

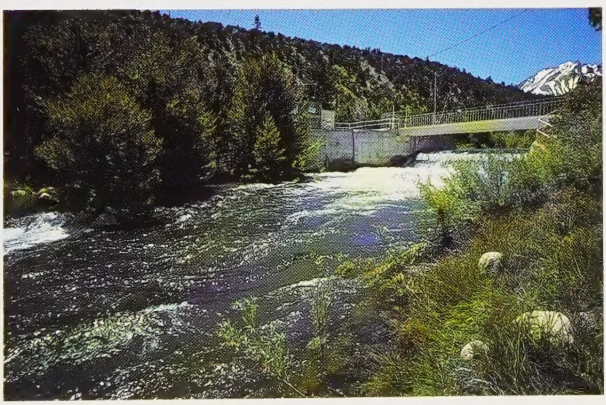
The Second Los Angeles Aqueduct, an $89 million conduit completed in 1970, was built to supplement the original aqueduct. Beginning at Haiwee Reservoir, the second aqueduct brings water to the distribution system at the north edge of the San Fernando Valley. This completed DWP's development of eastern Sierra water sources serving the City of Los Angeles. The new aqueduct added another 50% of capacity to the system. The Los Angeles Aqueducts now deliver an average of 430 million gallons per day, 75% of the City's water supply.

Energy from Water

Today, the Los Angeles Aqueduct System runs its course almost entirely by gravity, providing an opportunity to produce low-cost hydroelectric energy at 11 power plants along the aqueduct route. The result is a net gain of 1.12 billion kilowatt-hours of air pollution-free hydroelectric power. This is equivalent to the energy produced by the burning of 4,900 barrels of fuel oil each day and can supply the needs of 220,000 homes.



Hydroelectric power is generated at numerous power plants along the aqueduct route.



The aqueduct begins at the intake on Lee Vining Creek (right), and enters the City at the Cascades in the San Fernando Valley (above).

Recreation and Agriculture

Land management by DWP in the Owens River-Mono Basin area permits recreational, farming and ranching activities. Careful management of the natural resources is also improving the wildlife habitat at several locations within the watersheds.

Before the aqueduct water reaches Los Angeles, it provides a valuable recreational resource enjoyed by tens of thousands of outdoor enthusiasts who visit the eastern Sierra annually. DWP leases about 242,000 acres of the total 307,000 acres owned by the City in Inyo and Mono Counties for farming and ranching. Provisions in the leases require that not less than 75% of the leased area be kept open for public uses such as fishing, hunting and camping. The open land provision also benefits many residents of the Inyo-Mono area who derive their livelihood from the sports, recreation and vacation service industries.

Protecting and Enhancing the Owens Valley Environment

In 1984 Inyo County and Los Angeles, in an attempt to resolve their long-standing differences over water rights, entered into an agreement to set aside litigation and to jointly conduct vegetation and groundwater studies, implement several enhancement and beautification projects in the Owens Valley, and develop a long-term groundwater management plan. Various projects are underway, including revegetation, providing wildlife habitat, restoring a year-round flow in the lower Owens River, and the creation of other recreation areas.

DWP lands in the Owens Valley offer many uses, including agriculture, wildlife habitat, and recreation.

Metropolitan Water District

The remainder of Los Angeles' water supply is purchased from the Metropolitan Water District of Southern California. MWD supplies water on a wholesale basis to its member agencies. Founded in 1928 by Los Angeles and 10 other cities, the District began as part of an effort to construct facilities to bring Colorado River water to Southern California. Today, MWD includes 14 cities, 12 municipal water districts and a county water authority, in all serving more than 130 cities and many unincorporated areas in Southern California.

MWD delivers an average of 60 million gallons per day to Los Angeles from the Colorado River Aqueduct and the State Water Project. This represents about 10% of the City's total water use, and is about 4% of all MWD deliveries to its member agencies. Because it must be pumped along these aqueduct routes, MWD supplies are more costly and energy intensive than the City's other supplies. DWP's right to purchase water from MWD is very important as a source of additional future supplies and for use during a drought in the eastern Sierra.

Colorado River Aqueduct

In 1923, before MWD was established, Department of Water and Power engineers began investigating a route for an aqueduct to bring water from the Colorado River, and in 1925 the City voted $2 million to perform the engineering. Thirteen cities were members of the young District in 1931 when their citizens voted a $220 million bond issue to finance construction of the Colorado River Aqueduct. The project was completed in 1941 and brought water 300 miles to the Los Angeles area. The Colorado River Aqueduct now delivers

MWD's Colorado River Aqueduct stretches 300 miles across the Mojave Desert to deliver water to many areas of Southern California.

more than half a billion gallons daily to Southern California's coastal plain.

It was apparent early on that the average flow of the Colorado River was insufficient to meet the demands of the existing and future water projects of the Colorado River Basin states. As recently as 1985, MWD's entitlement from the Colorado River was cut by nearly 60% when the Central Arizona Project went on-line. To compensate for these foreseeable losses in the Colorado River supply, MWD contracted with the State Department of Water Resources in 1960 to obtain rights to nearly one-half of the then-proposed State Water Project supply.

State Water Project

The first phase of the $2.8 billion California State Water Project was finished in 1973. Completed units include Oroville Dam, the highest earthfill dam in the United States; Edmonston Pumping Plant, the largest single-lift pump station in the world; and the California Aqueduct, the world's longest aqueduct.

The State Water Project begins at the Feather River, almost 500 miles north of Los Angeles. The Feather and Sacramento River water is pumped from the Sacramento-San Joaquin Delta into the California Aqueduct. In Southern California the aqueduct splits into east and west branches, terminating at Perris and Castaic reservoirs, respectively.

The second phase of the project is a proposed system which will carry water from the Feather and Sacramento Rivers directly across the Sacramento-San Joaquin Delta to the intake pumps of the California Aqueduct. The system would complete the planned yield of the State Water Project, protect the fishery resources of the Delta, and control the quality of the water in the Delta and the Aqueduct.

Water from the Sacramento-San Joaquin Delta is brought to Southern California via the California Aqueduct.

Water Quality

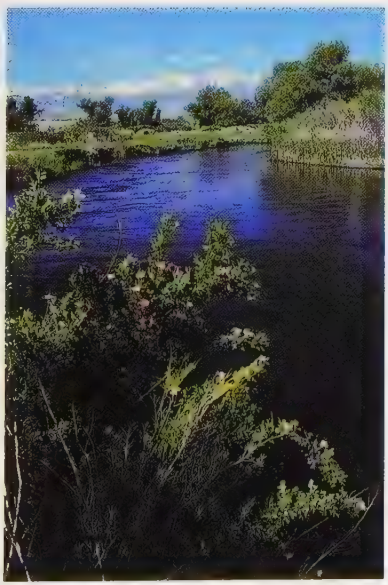
Los Angeles Aqueduct Supply

Waters of numerous lakes and streams, fed by melting snows on the eastern slope of the Sierra Nevada, flow into the Owens River and subsequently into the Los Angeles Aqueduct System. The lack of industry and intensive agriculture and the limited permanent population mean that the chance of polluting the Sierra runoff is minor. Although fishing is permitted at Crowley Lake, Grant Lake and Pleasant Valley Reservoir, it is not allowed in the other aqueduct reservoirs and in-town distribution reservoirs. After passing through Haiwee Reservoir in the southern Owens Valley, the water enters the enclosed aqueducts for the remainder of its journey to Los Angeles.

Before the water enters the covered portion of the aqueducts, small quantities of fine, dust-like particles find their way into the flow, often causing it to appear cloudy. The measure of the amount of these particles in the water is known as turbidity. Over the past decade, lowering of water levels in several of DWP's large storage reservoirs has decreased the time available for these particles to naturally settle out and reduce the turbidity of the water.

In addition, state and federal water quality standards adopted in the 1970s placed stricter limits on the level of turbidity permitted in water supplies. This is due to concerns that the particles interfere with disinfection of the water.

DWP determined that filtration would be necessary to reduce turbidity in the water and ensure the continued high quality of Los Angeles' most important water source.



Water quality at the source and at the tap.

Los Angeles Aqueduct Filtration Plant

In December 1986, Los Angeles completed its first water filtration plant, a $146 million project constructed at the terminal end of the City's aqueduct system. The Los Angeles Aqueduct Filtration Plant is designed to significantly reduce the level of turbidity in the aqueduct water and provide a safeguard against potential contamination from recreational uses in the eastern Sierra Nevada. The facility uses ozone and rapid-rate deep bed filters to treat up to 600 million gallons of water each day.

The facility is the largest direct filtration plant in the United States and the second largest ozone plant in the world. The Los Angeles Aqueduct Filtration Plant is delivering high quality, good-tasting water which meets all state and federal water quality standards.

Metropolitan Water District Sources

Water purchased from the Metropolitan Water District differs in quality from that of the City's own aqueducts. While the waters of the Colorado River and Delta also begin as rainfall and snowmelt, they travel great distances before they are diverted for consumer use.

As water travels down the Colorado River, it picks up amounts of dissolved minerals from the rocks, somewhat increasing its hardness. The Colorado River contains relatively little organic matter and is thus a very clean source of water.

Water obtained from the State Water Project is different in quality from the Colorado River supply. This is be-

The Los Angeles Aqueduct Filtration Plant treats up to 600 million gallons of water per day.

cause it contains greater amounts of organic matter resulting from the abundance of agriculture in the Sacramento-San Joaquin Delta. The water delivered by the California Aqueduct thus has a higher potential for bacteriological contamination. MWD operates several treatment plants to filter both the State Water Project and Colorado River Aqueduct supplies.

Because of the presence of natural organics in the State Project water, MWD uses chloramines to disinfect all its water supplies. This is to ensure against forming certain by-products which result when chlorine is added to water which is high in organics. Los Angeles continues to use chlorine to disinfect its own water sources because of the very low levels of organics found in its supplies.

Maintaining the quality of the State Water Project supply is of great importance since this source will replace the increasing quantities of water no longer available from the Colorado River.

Local Groundwater Supplies

Groundwater from the San Fernando Valley and other local basins is generally of very good quality, being free of bacteriological contaminants and turbidity which are water quality factors generally associated with surface water supplies.

In 1980, it was discovered that trace amounts of organic solvents were present in some of the well water taken from the San Fernando Valley Groundwater Basin. The contamination is believed to have resulted from improper disposal of chemicals over several decades. The concentrations of the contaminants in certain areas of the valley have caused some wells to be removed from service. Other wells have been blended with Los Angeles Aqueduct supplies to bring the water to within state guide lines.

DWP and other local agencies have conducted studies to determine the extent of the contamination in the Valley Basin. DWP and the U.S. Environmental Protection Agency are jointly investigating measures to clean up the basin and protect against further degradation of the underground supply. As a first phase of a comprehensive program, DWP has built a treatment facility in the North Hollywood area to remove the contaminants from the water and prevent them from spreading to more wells. This and other measures will help ensure the high quality and continued use of the basin water.

Maintaining Water Quality

Los Angeles water consistently meets all federal and state water quality standards. It is not only safe, but is one of the best tasting municipal water supplies in the nation.

The Department of Water and Power continually monitors the purity and quality of the water supply. More than 60,000 laboratory and field analyses are made each year. About 15,000 of these tests are for bacteriological control, and the remainder are for chemical, physical, and radiological inspections.

Analyses are made of water samples taken from watersheds, reservoirs, distribution mains and consumers' taps. All water-carrying and storage facilities are checked periodically.

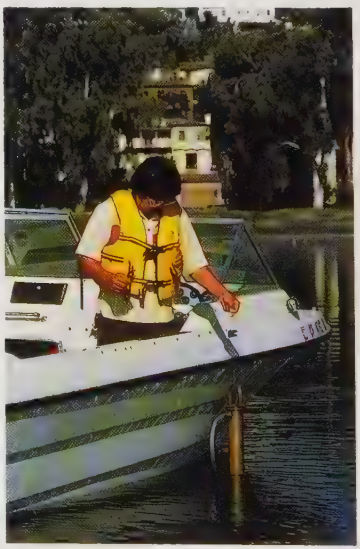
The hardness of all the City's water sources is below recommended standards for drinking and domestic uses. Los Angeles Aqueduct water has an average hardness of about 73 parts per million, while local groundwater and water purchased from MWD are slightly higher in hardness.

All water is treated before it enters the City's mains by the application of chlorine to ensure its safety. Control devices automatically adjust the chlorine feed rate to achieve the desired residual in the system of one part per million.

Measures are taken to protect the water against harmless algae growths which may impart a taste or odor to the water are materially reduced. Many small reservoirs have roofs which keep out the sun's rays, and large open reservoirs are treated to control algae growths.

DWP is working to cover the remainder of its small open reservoirs or replace them with tanks. This is being done to meet State Department of Health Services recommendations which will further prevent airborne contamination of the water as well as reduce the growth of algae in the direct sunlight.

The potential for further contamination of the San Fernando Valley groundwater is minimized through city, county, and state programs designed to manage hazardous materials and waste. Regulation of underground storage tanks and private sewage disposal systems, hazardous waste disposal programs for small industries, monitoring of landfills, and increased public education highlight the efforts of the public agencies.



Water samples are tested daily to ensure that quality is maintained.

Water Storage

Water demands vary with the time of day and with changing weather conditions. Hot weather, large fires, and other emergencies can cause a sharp rise in water consumption. Maintaining sufficient flow of water at adequate pressure under varying demand conditions requires the storage of water.

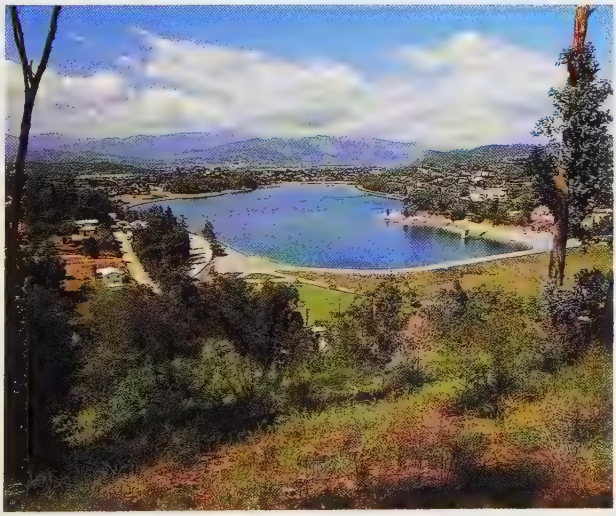
Water is stored in seven reservoirs along the Los Angeles Owens River Aqueduct route and five large reservoirs in the City. The Water System altogether includes more than 100 storage facilities, ranging from large open reservoirs to small steel or concrete storage tanks.

The smallest open reservoir has a capacity of 31 million gallons; the largest, Crowley Lake in the Owens Valley, can hold 183,000 acre-feet, or about 60 billion gallons. Storage tank capacities vary from 10,000 to 10 million gallons. Combined storage capacities of all reservoirs and tanks is about 365,000 acre-feet, or approximately 119 billion gallons.

Water Distribution

The municipal Water System serves Los Angeles' population of about 3.4 million people through some 660,000 service connections. DWP installs and maintains pipe mains and fire hydrants year round to meet the City's demands for water. Including business and industrial uses, water consumption averages about 180 gallons per person per day, amounting to an average 560 million gallons which must be supplied daily.

Water is distributed to customer service connections through more than 7,000 miles of water mains, ranging from 4 inches to 10 feet in diameter. Because of the unusual range in elevation (sea level to 2,400 feet), the City's 464-square mile area has been divided into 102 pressure zones. Most of the 85 booster pumping stations are designed



Left: Silver Lake Reservoir is one of five large in-city reservoirs that provide water storage for major portions of Los Angeles.

Above: Modern pumping stations designed as houses blend with the surrounding neighborhood.

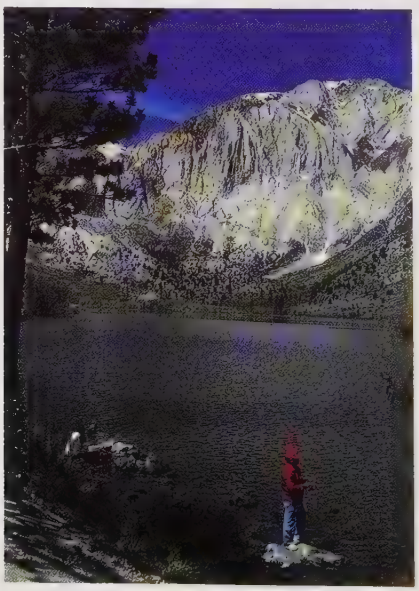
to provide water service at elevations higher than the gravity system can supply. In general, a minimum water pressure of 43 pounds per square inch is maintained to the customer. If necessary, pressure is regulated by the customer to a maximum of 80 pounds per square inch.

Several programs are underway to upgrade the water distribution system, parts of which have served the City since the turn of the century. Aging pipes and system components are being replaced under an extensive infrastructure program. Cleaning and cement-mortar lining of older pipelines has been increased dramatically as a cost-effective way of extending pipe life, and now includes the renovation of 4- and 6-inch lines. A pipeline flushing program eliminates accumulated sediment which improves the efficiency of the delivery system.

The operation of the distribution system is being computerized to allow for better monitoring and control of the numerous water system facilities. The Water System's Data Acquisition and Control system will monitor reservoir levels, water flow and pressure, the operation of chlorination stations, and the status of pumps and valves at locations over the entire City. The centralized computer system will allow operators to react immediately to changing field conditions and emergencies.

Water Finances

The daily operation and maintenance of the Los Angeles Water System are paid from current water revenues generated from water sales. The System construction program is financed by current water revenues and by the issuance of revenue bonds to be repaid from future revenues. Thus, operations of the Water System are entirely self-supporting and no financial obligation or tax burden is placed on the citizens of Los Angeles.



The beauty of the eastern Sierra attracts visitors looking for a change of pace.

Water Rates

Water rates of the municipal Water System compare well with those of other large cities, even those obtaining their water from nearby sources.

Los Angeles' water service rate includes a fixed service availability charge determined by service size and a commodity charge based on the amount of water used. Commodity charge rates are subject to adjustment based on the cost of water purchased from MWD and the cost of electricity used for pumping. Since 1985, the commodity charge to residential and industrial-commercial customers has been identical.

To encourage water conservation, DWP initiated a seasonal pricing structure in 1986 which established two different commodity charges based on time of year, with water rates in the summer season being higher than in the winter.

DWP offers a special "lifeline service" to eligible senior citizens and disabled persons. The lifeline service provides lower rates for both service availability and commodity charges.

All water rates are subject to approval by the Mayor and City Council of Los Angeles.

Water Conservation

DWP is taking an active role in promoting the efficient use of the City's valuable water resources. Conservation programs aimed at reducing both indoor and outdoor water use have been developed to encourage residents, businesses, and industries to save water.

Water saving information is available to commercial and industrial users free of charge. Water audits are also provided to managers of parks and other large turf properties to recommend ways to optimize watering practices. Free water conservation kits have been provided to more than one and one-half million residential customers, along with a number of other guides and pamphlets on water saving tips.

A special education series is provided to local schools to teach the importance of water conservation. DWP is also studying the effectiveness of various irrigation programs and is co-sponsoring an annual water conservation garden contest.

DWP conservation advisors teach customers how to save water.

Water Reclamation

DWP actively promotes the use of highly treated wastewater as an alternate source of water for irrigation and industrial users.

The Los Angeles Department of Public Works operates the Donald C. Tillman Water Reclamation Plant in the San Fernando Valley and the jointly owned Los Angeles-Glendale Water Reclamation Plant in the Griffith Park area. The plants were constructed to reduce the overload on the City's sewage system, and they produce large volumes of reusable-quality water.

The Department of Recreation and Parks is currently using about one million gallons per day of reclaimed water from the Los Angeles-Glendale Plant for golf course irrigation in Griffith Park. Studies are underway to expand the use of reclaimed water for park irrigation and for turf and landscape irrigation in greenbelt areas near Griffith Park. DWP delivers a portion of this plant's outflow to Caltrans for irrigation of seven miles of Golden State Freeway landscape.

Projects are also being implemented to reuse water from the Tillman Plant. These include large scale uses in the Sepulveda Basin recreational area, decorative uses at the plant's own Japanese gardens, and a pilot groundwater recharge project.

DWP continues to investigate economical uses for this important source of irrigation and industrial quality water. Increases in water reuse will offset the quantities of water that DWP must purchase or import.

Facts in Brief

Service area	465 square miles
Population serviced	3.4 million
Customers	660,000
Average daily total demand	580 million gallons
Average daily use per capita	185 gallons
Reservoirs and tanks	108
Storage capacity	365,000 acre-feet
Distribution mains	7,030 miles
Pump stations	85
Fire hydrants	54,000

Reclaimed water used to irrigate parks and landscapes conserves the City's fresh water supplies.


California Aqueduct
West Branch
(State)
338 Mile Los Angeles
Owens River Aqueduct System
Castaic
Reservoir
(State)
Bouquet Reservoir
Jensen
Filtration
Plant
(MWD)
Second Los Angeles
Aqueduct System
Maclay
Reservoir
Los Angeles
Reservoir Complex
L.A. Aqueduct
Filtration Plant
Green Verdugo Reservoir
North Hollywood Wells
Los Angeles River
Hollywood
Reservoirs
Encino
Reservoir
Eagle Rock Reservoir
Silver Lake
Reservoir
Stone Canyon
Reservoirs
Franklin
Canyon
Reservoir
Santa Ynez
Reservoir
Elysian
Reservoir
Los Angeles River
Palos Verdes
Reservoir
(MWD)
San Pedro Reservoir

Your Los Angeles DWP Department of Water and Power

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